

**Supplement Table 1.** Action potential and patch clamp recording solutions.

Conventional Patch Clamp Extracellular Solution (mM)								
	I <sub>Na</sub>	I <sub>Ca</sub>	I <sub>Kr</sub>	I <sub>Ks</sub>	I <sub>f</sub>	I <sub>K1</sub>	I <sub>to</sub>	AP
NaCl	50		150	150	135			150
TEA-Cl		160						
NMDG						160	160	
KCl			5.4	5.4	5.4	5.4	5.4	5.4
CaCl <sub>2</sub>	1.8	5	1.8	1.8	1.8			1.8
MgCl <sub>2</sub>	1	1	1	1	1	2	2	1
CsCl <sub>2</sub>	110							
Glucose	10	10	15	15	10	10	10	15
HEPES	10	10	15	15	10	10	10	15
NaHCO <sub>3</sub>								
NaH <sub>2</sub> PO <sub>4</sub>								
Glutamax					2			
Na-Pyruvate			1	1	1			1
MEM vitamins					1			
MEM AA					1:100*			
MEM NEAA					1:50*			
BaCl <sub>2</sub>					0.5			
Nifedipine	0.001		0.002	0.001		0.01	0.01	
E-4031				0.0005		0.0001	0.0001	
TTX		0.01					0.01	
4-AP		2						
pH 7.4	CsOH	CsOH	NaOH	NaOH	NaOH	HCl	HCl	NaOH

MEM: Minimum Essential Medium. AA: Amino Acids. NEAA: Non-essential Amino Acids.

NMDG: N-methyl-d-glucamine. \* diluted from purchased stock solution

Conventional Patch Clamp Intracellular Solution (mM)								
	I <sub>Na</sub>	I <sub>Ca</sub>	I <sub>Kr</sub>	I <sub>Ks</sub>	I <sub>f</sub>	I <sub>K1</sub>	I <sub>to</sub>	AP
KCl			150	20	150			150
K-Gluconate						150	150	
CsCl <sub>2</sub>	135	145						
NaCl	10	5	5		5			5
CaCl <sub>2</sub>	2	2	2		2			2
EGTA	5	5	5	10	5	5	5	5
HEPES	10	10	10	5	10	10	10	10
MgATP	5	5	5	5	5	5	5	5
K-Aspartate				125				
MgCl <sub>2</sub>				1				
Na <sub>2</sub> -Phosphocreatine				2				
Na <sub>2</sub> -GTP				2				
Gramicidin (μg/ml)							50	
pH 7.2	CsOH	CsOH	KOH	KOH	KOH	KOH	KOH	KOH

**Supplement Table 1 (continued).** Action potential and patch clamp recording solutions.

	Planar (Automated) Patch Clamp Solutions (mM)							
	Extracellular			Intracellular				
	Sealing	I <sub>Na</sub>	I <sub>Ca</sub>	I <sub>Kr</sub>		I <sub>Na</sub>	I <sub>Ca</sub>	I <sub>Kr</sub>
NaCl	150	50		15	KCl			20
TEA-Cl			150		K-aspartate			120
K-aspartate		110			Cs-gluconate	130		
KCl	4			140	CsOH		110	
CaCl <sub>2</sub>	1.2	1.8	1.8	1.2	L-glutamic Acid		110	
MgCl <sub>2</sub>	1	1	0.5	1	CsCl	5	20	
CsCl <sub>2</sub>					NaCl	5		
Glucose		10	5.5		MgCl <sub>2</sub>	1	3	6
Na-HEPES	10	10	5	10	MgATP	2		
4-AP			3		Li-GTP	0.2		
pH 7.4	HCl	HCl	HCl	HCl	Na <sub>2</sub> -ATP		5	5
					GTP-tris		0.4	
					Creatine phos-Na <sub>2</sub>		5	
					Leupeptin		0.1	
					EGTA	0.5	10	5
					HEPES	10	5	10
					pH 7.2	Gluconic acid	CsOH	KOH

**Supplemental Table 2.** Ion channel currents and gating in native human cardiomyocytes.

	Cell type	Current density (pA/pF)	Activation		Inactivation		Disease or Control	Ref
			$V_{1/2}$ (mV)	k (mV/e-fold $\Delta$ )	$V_{1/2}$ (mV)	k (mV/e-fold $\Delta$ )		
$I_{Na}$	V	-25.8±8.1	-42.8±1.1	5.98±0.18	-97.3±1.1	5.77±0.10	Disease	(13)
	A	-17.8±1.4	-38.9±0.9	6.5±0.1	-95.8±0.9	5.3±0.1	Disease	(14)
	A	~-35	-38.6±2.9	7.2±0.5	-95.1±5.4	7.4±0.3	Disease	(4)
$I_{Ca}$	V	-5.8±0.5	-6.02	7.16	-20.4	6.49	Disease	(11)
	A	-2.6±0.3	NA	NA	NA	NA	Control	(15)
$I_{Kr}$	V	0.6±0.08	NA	NA	NA	NA	Control	(8)
	V	~-0.4	-14±4	7.7±2.7	NA	NA	Disease	(10)
	V	~0.25	-5.74	5.63	NA	NA	Control	(7)
	V	NR	-29.9	9.5	NA	NA	Disease	(16)
	V	NP	NA	NA	NA	NA	Control	(9)
	A	NR	-14.0±3.3	6.5±1.5	NA	NA	Disease	(18)
$I_{Ks}$	V	~0.18	NA	NA	NA	NA	Control	(17)
	V	NP	NA	NA	NA	NA	Control	(7)
	V	NP	NA	NA	NA	NA	Disease	(16)
	A	NR	19.9±4.2	12.7±2.5	NA	NA	Disease	(18)
$I_{to}$	V (Epi)	6.8±0.4	9.7±1.6	15.4±0.7	-31.9±1.5	-4.6±0.2	Control	(19)
		7.9±0.7	9.2±1.8	13.0±0.6	-30.5±1.2	-4.5±0.2	Disease	
	V (Endo)	4.4±1.1	23.1±4.2	12.9±0.8	-25.3±3.0	-4.7±0.8	Control	
		2.3±0.3	25.6±3.5	18.1±1.6	34.6±2.0	-8.7±1.0	Disease	
	V	9.2±1.0	NR	NR	NR	NR	Control	(2)
		5.8±0.6	NR	NR	NR	NR	Disease	
	V (Epi)	7.2±0.4	-8.9±0.19	6.2±0.2	-36.3±0.4	5.6±03	Control	(9)
	V (Endo)	6.0±0.5	-7.8±0.2	5.7±0.2	-33.0±04	5.2±02		
	A	~13	14.9±1.2	9.4±0.6	-33.5±4.8	NA	Disease	(4)
$I_{K1}$	V	~-0.48	NA	NA	NA	NA	Control	(8)
	V	-0.57±0.15	NA	NA	-154.8±2.1	8.1±1.1	Disease	(1)
	V (Epi)	-18.2±1.4	NA	NA	NA	NA	Control	(9)
	V (Endo)	-18.7±1.0	NA	NA	NA	NA		
	A	-0.23±0.09 and -2.18±0.39	NA	NA	NA	NA	Disease	(5)
	V	-1.38±0.14	-110.96±0.06	12.26±0.06	NA	NA	Disease	(6)
		-1.18±0.21	NA	NA	NA	NA	Control	
$I_f$	V	-2.1±0.3	-70.9±2.1	5.4±0.3	NA	NA	Disease	(3)
	A	-2.6±0.2	-89.3±0.7	12.7±0.7	NA	NA	Disease	(5)
	A	-3.77±0.25	-86.68±2.19	-11.39±0.7	NA	NA	Disease	(12)

A=atrial, V=ventricular, Epi=ventricular epicardial, Endo=ventricular endocardial, NA=not assessed or measured. NP=current either not present or reported as too small to quantify. NR=current measured but value not reported. ~ estimated from figure.

## On-line supplement

### On-line references

1. **Bailly P, Mouchoniere M, Benitah JP, Camilleri L, Vassort G, and Lorente P.** Extracellular K+ dependence of inward rectification kinetics in human left ventricular cardiomyocytes. *Circulation* 98: 2753-2759, 1998.
2. **Beuckelmann DJ, Nabauer M, and Erdmann E.** Alterations of K+ currents in isolated human ventricular myocytes from patients with terminal heart failure. *Circ Res* 73: 379-385, 1993.
3. **Cerbai E, Pino R, Porciatti F, Sani G, Toscano M, Maccherini M, Giunti G, and Mugelli A.** Characterization of the hyperpolarization-activated current, I(f), in ventricular myocytes from human failing heart. *Circulation* 95: 568-571, 1997.
4. **Feng J, Li GR, Fermini B, and Nattel S.** Properties of sodium and potassium currents of cultured adult human atrial myocytes. *Am J Physiol* 270: H1676-1686, 1996.
5. **Hoppe UC, and Beuckelmann DJ.** Characterization of the hyperpolarization-activated inward current in isolated human atrial myocytes. *Cardiovasc Res* 38: 788-801, 1998.
6. **Hoppe UC, Jansen E, Sudkamp M, and Beuckelmann DJ.** Hyperpolarization-activated inward current in ventricular myocytes from normal and failing human hearts. *Circulation* 97: 55-65, 1998.
7. **Iost N, Virag L, Opincariu M, Szecsi J, Varro A, and Papp JG.** Delayed rectifier potassium current in undiseased human ventricular myocytes. *Cardiovasc Res* 40: 508-515, 1998.
8. **Jost N, Acsai K, Horvath B, Banyasz T, Bacsko I, Bitay M, Bogats G, and Nanasi PP.** Contribution of I Kr and I K1 to ventricular repolarization in canine and human myocytes: is there any influence of action potential duration? *Basic Res Cardiol* 104: 33-41, 2009.
9. **Konarzewska H, Peeters GA, and Sanguinetti MC.** Repolarizing K+ currents in nonfailing human hearts. Similarities between right septal subendocardial and left subepicardial ventricular myocytes. *Circulation* 92: 1179-1187, 1995.
10. **Li GR, Feng J, Yue L, Carrier M, and Nattel S.** Evidence for two components of delayed rectifier K+ current in human ventricular myocytes. *Circ Res* 78: 689-696, 1996.
11. **Pelzmann B, Schaffer P, Bernhart E, Lang P, Machler H, Rigler B, and Koidl B.** L-type calcium current in human ventricular myocytes at a physiological temperature from children with tetralogy of Fallot. *Cardiovasc Res* 38: 424-432, 1998.
12. **Porciatti F, Pelzmann B, Cerbai E, Schaffer P, Pino R, Bernhart E, Koidl B, and Mugelli A.** The pacemaker current I(f) in single human atrial myocytes and the effect of beta-adrenoceptor and A1-adenosine receptor stimulation. *Br J Pharmacol* 122: 963-969, 1997.
13. **Sakakibara Y, Furukawa T, Singer DH, Jia H, Backer CL, Arentzen CE, and Wasserstrom JA.** Sodium current in isolated human ventricular myocytes. *Am J Physiol* 265: H1301-1309, 1993.
14. **Sakakibara Y, Wasserstrom JA, Furukawa T, Jia H, Arentzen CE, Hartz RS, and Singer DH.** Characterization of the sodium current in single human atrial myocytes. *Circ Res* 71: 535-546, 1992.
15. **Tipparaju SM, Kumar R, Wang Y, Joyner RW, and Wagner MB.** Developmental differences in L-type calcium current of human atrial myocytes. *Am J Physiol Heart Circ Physiol* 286: H1963-1969, 2004.
16. **Veldkamp MW, van Ginneken AC, Ophof T, and Bouman LN.** Delayed rectifier channels in human ventricular myocytes. *Circulation* 92: 3497-3504, 1995.
17. **Virag L, Iost N, Opincariu M, Szolnoky J, Szecsi J, Bogats G, Szenohradsky P, Varro A, and Papp JG.** The slow component of the delayed rectifier potassium current in undiseased human ventricular myocytes. *Cardiovasc Res* 49: 790-797, 2001.
18. **Wang Z, Fermini B, and Nattel S.** Rapid and slow components of delayed rectifier current in human atrial myocytes. *Cardiovasc Res* 28: 1540-1546, 1994.
19. **Wettwer E, Amos GJ, Posival H, and Ravens U.** Transient outward current in human ventricular myocytes of subepicardial and subendocardial origin. *Circ Res* 75: 473-482, 1994.